

ON Semiconductor

Is Now

onsemi™

To learn more about onsemi™, please visit our website at
www.onsemi.com

onsemi and **onsemi** and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi** product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner. Other names and brands may be claimed as the property of others.

CAT93C46R

EEPROM Serial 1-Kb Microwire

Description

The CAT93C46R is a 1-Kb Microwire Serial EEPROM device which is organized as either 64 registers of 16 bits or 128 registers of 8 bits, as determined by the state of the ORG pin. The CAT93C46R features sequential read and self-timed internal write with auto-clear. On-chip Power-On Reset circuitry protects the internal logic against powering up in the wrong state.

In contrast to the CAT93C46, the CAT93C46R features an internal instruction clock counter which provides improved noise immunity for Write/Erase commands.

Features

- High Speed Operation: 4 MHz @ 5 V, 2 MHz @ 1.8 V
- 1.8 V to 5.5 V Supply Voltage Range
- Selectable x8 or x16 Memory Organization
- Sequential Read
- Software Write Protection
- Power-up Inadvertant Write Protection
- Low Power CMOS Technology
- 1,000,000 Program/Erase Cycles
- 100 Year Data Retention
- Industrial Temperature Range
- 8-pin PDIP, SOIC, TSSOP and 8-pad TDFN Packages
- This Device is Pb-Free, Halogen Free/BFR Free and RoHS Compliant*

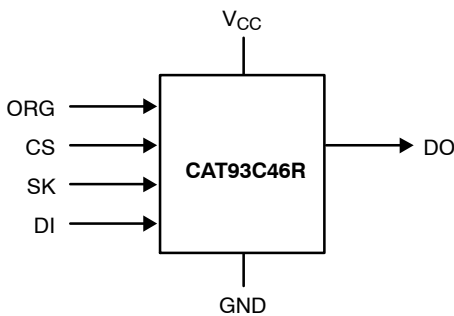


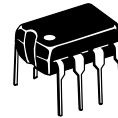
Figure 1. Functional Symbol

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

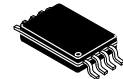


ON Semiconductor®

www.onsemi.com



PDIP-8
L SUFFIX
CASE 646AA



TSSOP-8
Y SUFFIX
CASE 948AL

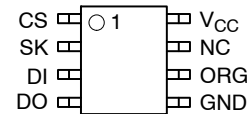


SOIC-8
V SUFFIX
CASE 751BD



TDFN-8**
VP2 SUFFIX
CASE 511AK

PIN CONFIGURATION



PDIP (L), SOIC (V),
TSSOP (Y), TDFN (VP2)**

(Top View)

** Not recommended for new designs

PIN FUNCTION

Pin Name	Function
CS	Chip Select
SK	Clock Input
DI	Serial Data Input
DO	Serial Data Output
V _{CC}	Power Supply
GND	Ground
ORG	Memory Organization
NC	No Connection

Note: When the ORG pin is connected to V_{CC}, the x16 organization is selected. When it is connected to ground, the x8 pin is selected. If the ORG pin is left unconnected, then an internal pull-up device will select the x16 organization.

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

CAT93C46R

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Value	Units
Storage Temperature	-65 to +150	°C
Voltage on Any Pin with Respect to Ground (Note 1)	-0.5 to +6.5	V

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

- The DC input voltage on any pin should not be lower than -0.5 V or higher than $V_{CC} + 0.5$ V. During transitions, the voltage on any pin may undershoot to no less than -1.5 V or overshoot to no more than $V_{CC} + 1.5$ V, for periods of less than 20 ns.

Table 2. RELIABILITY CHARACTERISTICS (Note 2)

Symbol	Parameter	Min	Units
N_{END} (Note 3)	Endurance	1,000,000	Program / Erase Cycles
T_{DR}	Data Retention	100	Years

- These parameters are tested initially and after a design or process change that affects the parameter according to appropriate AEC-Q100 and JEDEC test methods.
- Block Mode, $V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$

Table 3. D.C. OPERATING CHARACTERISTICS ($V_{CC} = +1.8$ V to +5.5 V, unless otherwise specified.)

Symbol	Parameter	Test Conditions	Min	Max	Units
I_{CC1}	Power Supply Current (Write)	$f_{SK} = 1$ MHz $V_{CC} = 5.0$ V		1	mA
I_{CC2}	Power Supply Current (Read)	$f_{SK} = 1$ MHz $V_{CC} = 5.0$ V		500	μA
I_{SB1}	Power Supply Current (Standby) (x8 Mode)	CS = 0 V ORG = GND		10	μA
I_{SB2}	Power Supply Current (Standby) (x16 Mode)	CS = 0 V ORG = Float or V_{CC}		10	μA
I_{LI}	Input Leakage Current	$V_{IN} = 0$ V to V_{CC}		2	μA
I_{LO}	Output Leakage Current (Including ORG pin)	$V_{OUT} = 0$ V to V_{CC} , CS = 0 V		2	μA
V_{IL1}	Input Low Voltage	$4.5 \text{ V} \leq V_{CC} < 5.5 \text{ V}$	-0.1	0.8	V
V_{IH1}	Input High Voltage	$4.5 \text{ V} \leq V_{CC} < 5.5 \text{ V}$	2	$V_{CC} + 1$	V
V_{IL2}	Input Low Voltage	$1.8 \text{ V} \leq V_{CC} < 4.5 \text{ V}$	0	$V_{CC} \times 0.2$	V
V_{IH2}	Input High Voltage	$1.8 \text{ V} \leq V_{CC} < 4.5 \text{ V}$	$V_{CC} \times 0.7$	$V_{CC} + 1$	V
V_{OL1}	Output Low Voltage	$4.5 \text{ V} \leq V_{CC} < 5.5 \text{ V}$ $I_{OL} = 2.1$ mA		0.4	V
V_{OH1}	Output High Voltage	$4.5 \text{ V} \leq V_{CC} < 5.5 \text{ V}$ $I_{OH} = -400$ μA	2.4		V
V_{OL2}	Output Low Voltage	$1.8 \text{ V} \leq V_{CC} < 4.5 \text{ V}$ $I_{OL} = 1$ mA		0.2	V
V_{OH2}	Output High Voltage	$1.8 \text{ V} \leq V_{CC} < 4.5 \text{ V}$ $I_{OH} = -100$ μA	$V_{CC} - 0.2$		V

CAT93C46R

Table 4. PIN CAPACITANCE

Symbol	Test	Conditions	Min	Typ	Max	Units
C_{OUT} (Note 4)	Output Capacitance (DO)	$V_{OUT} = 0\text{ V}$			5	pF
C_{IN} (Note 4)	Input Capacitance (CS, SK, DI, ORG)	$V_{IN} = 0\text{ V}$			5	pF

4. These parameters are tested initially and after a design or process change that affects the parameter according to appropriate AEC-Q100 and JEDEC test methods.

Table 5. A.C. CHARACTERISTICS (Note 5)

Symbol	Parameter	$V_{CC} = 1.8\text{ V} - 5.5\text{ V}$		$V_{CC} = 4.5\text{ V} - 5.5\text{ V}$		Units
		Min	Max	Min	Max	
t_{CSS}	CS Setup Time	50		50		ns
t_{CSH}	CS Hold Time	0		0		ns
t_{DIS}	DI Setup Time	100		50		ns
t_{DIH}	DI Hold Time	100		50		ns
t_{PD1}	Output Delay to 1		0.25		0.1	μs
t_{PD0}	Output Delay to 0		0.25		0.1	μs
t_{HZ} (Note 6)	Output Delay to High-Z		100		100	ns
t_{EW}	Program/Erase Pulse Width		5		5	ms
t_{CSMIN}	Minimum CS Low Time	0.25		0.1		μs
t_{SKHI}	Minimum SK High Time	0.25		0.1		μs
t_{SKLOW}	Minimum SK Low Time	0.25		0.1		μs
t_{SV}	Output Delay to Status Valid		0.25		0.1	μs
SK_{MAX}	Maximum Clock Frequency	DC	2	DC	4	MHz

5. Test conditions according to "A.C. Test Conditions" table.

6. These parameters are tested initially and after a design or process change that affects the parameter according to appropriate AEC-Q100 and JEDEC test methods.

Table 6. POWER-UP TIMING (Notes 4 and 7)

Symbol	Parameter	Max	Units
t_{PUR}	Power-up to Read Operation	1	ms
t_{PUW}	Power-up to Write Operation	1	ms

7. t_{PUR} and t_{PUW} are the delays required from the time V_{CC} is stable until the specified operation can be initiated.

Table 7. A.C. TEST CONDITIONS

Input Rise and Fall Times	$\leq 50\text{ ns}$	
Input Pulse Voltages	0.4 V to 2.4 V	$4.5\text{ V} \leq V_{CC} \leq 5.5\text{ V}$
Timing Reference Voltages	0.8 V, 2.0 V	$4.5\text{ V} \leq V_{CC} \leq 5.5\text{ V}$
Input Pulse Voltages	$0.2 V_{CC}$ to $0.7 V_{CC}$	$1.8\text{ V} \leq V_{CC} \leq 4.5\text{ V}$
Timing Reference Voltages	$0.5 V_{CC}$	$1.8\text{ V} \leq V_{CC} \leq 4.5\text{ V}$
Output Load	Current Source I_{OLmax}/I_{OHmax} ; $C_L = 100\text{ pF}$	

CAT93C46R

Table 8. INSTRUCTION SET

Instruction	Start Bit	Opcode	Address		Data		Comments
			x8	x16	x8	x16	
READ	1	10	A6–A0	A5–A0			Read Address AN–A0
ERASE	1	11	A6–A0	A5–A0			Clear Address AN–A0
WRITE	1	01	A6–A0	A5–A0	D7–D0	D15–D0	Write Address AN–A0
EWEN	1	00	11XXXXX	11XXXX			Write Enable
EWDS	1	00	00XXXXX	00XXXX			Write Disable
ERAL	1	00	10XXXXX	10XXXX			Clear All Addresses
WRAL	1	00	01XXXXX	01XXXX	D7–D0	D15–D0	Write All Addresses

Device Operation

The CAT93C46R is a 1024-bit nonvolatile memory intended for use with industry standard microprocessors. The CAT93C46R can be organized as either registers of 16 bits or 8 bits. When organized as X16, seven 9-bit instructions control the reading, writing and erase operations of the device. When organized as X8, seven 10-bit instructions control the reading, writing and erase operations of the device. The CAT93C46R operates on a single power supply and will generate on chip the high voltage required during any write operation.

Instructions, addresses, and write data are clocked into the DI pin on the rising edge of the clock (SK). The DO pin is normally in a high impedance state except when reading data from the device, or when checking the ready/busy status after a write operation.

The ready/busy status can be determined after the start of a write operation by selecting the device (CS high) and polling the DO pin; DO low indicates that the write operation is not completed, while DO high indicates that the device is ready for the next instruction. If necessary, the DO pin may be placed back into a high impedance state during chip select by shifting a dummy “1” into the DI pin. The DO pin will enter the high impedance state on the rising edge of the clock (SK). Placing the DO pin into the high impedance state is recommended in applications where the DI pin and the DO pin are to be tied together to form a common DI/O pin. The Ready/Busy flag can be disabled only in Ready state; no change is allowed in Busy state.

The format for all instructions sent to the device is a logical “1” start bit, a 2-bit (or 4-bit) opcode, 6-bit address (an additional bit when organized X8) and for write operations a 16-bit data field (8-bit for X8 organization).

Read

Upon receiving a READ command and an address (clocked into the DI pin), the DO pin of the CAT93C46R will come out of the high impedance state and, after sending an initial dummy zero bit, will begin shifting out the data addressed (MSB first). The output data bits will toggle on the rising edge of the SK clock and are stable after the specified time delay (t_{PD0} or t_{PD1}).

Sequential Read

After the 1st data word has been shifted out and CS remains asserted with the SK clock continuing to toggle, the CAT93C46R will automatically increment to the next address and shift out the next data word. As long as CS is continuously asserted and SK continues to toggle, the device will keep incrementing to the next address automatically until it reaches the end of the address space, then loops back to address 0. In the sequential Read mode, only the initial data word is preceded by a dummy zero bit; all subsequent data words will follow without a dummy zero bit.

Erase/Write Enable and Disable

The CAT93C46R powers up in the write disable state. Any writing after power-up or after an EWDS (write disable) instruction must first be preceded by the EWEN (write enable) instruction. Once the write instruction is enabled, it will remain enabled until power to the device is removed, or the EWDS instruction is sent. The EWDS instruction can be used to disable all CAT93C46R write and erase instructions, and will prevent any accidental writing or clearing of the device. Data can be read normally from the device regardless of the write enable/disable status.

CAT93C46R

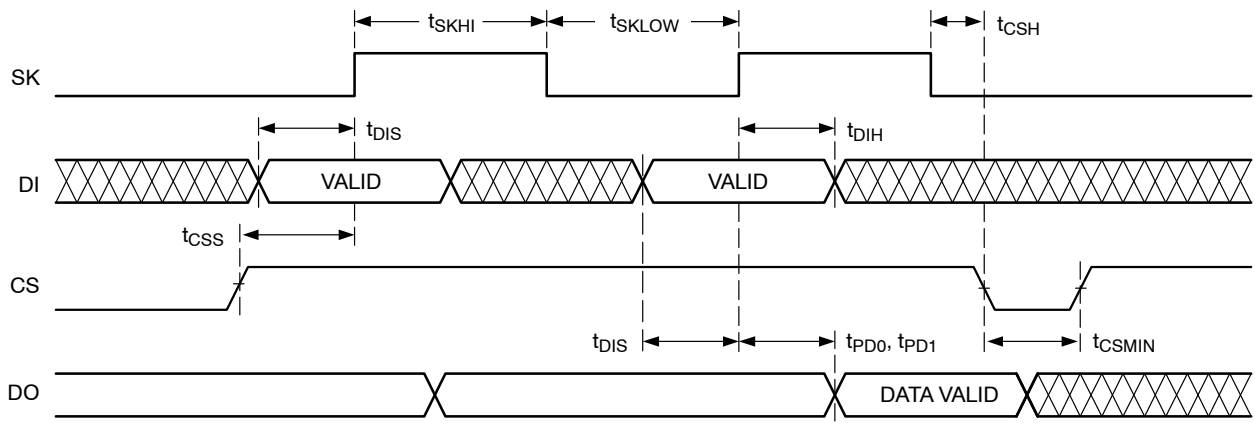


Figure 2. Synchronous Data Timing

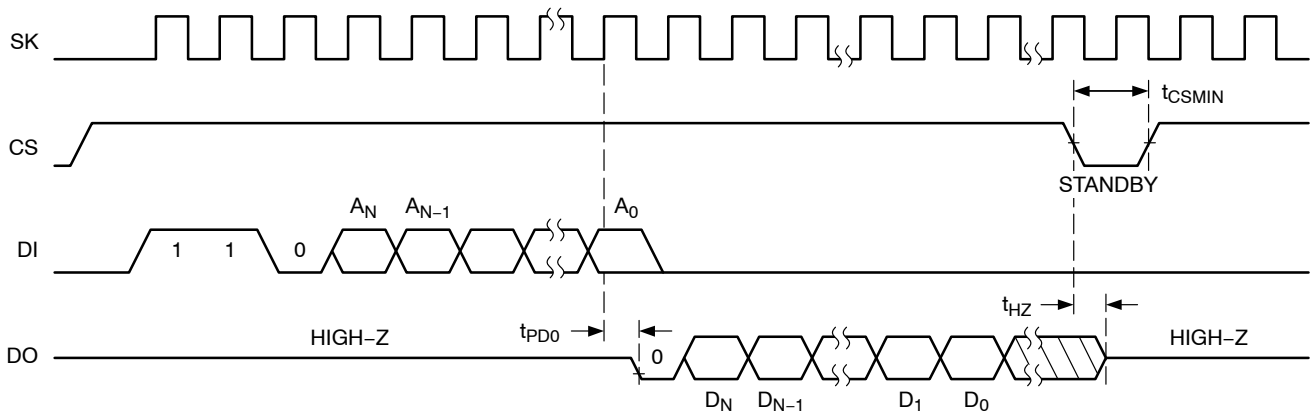


Figure 3. Read Instruction Timing

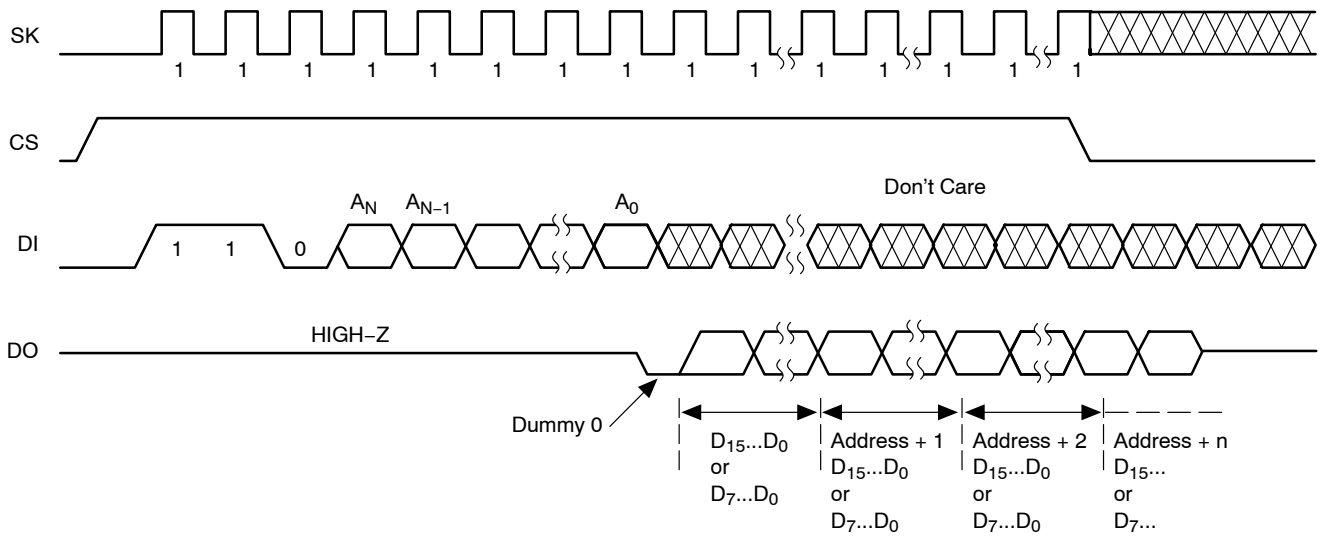


Figure 4. Sequential Read Instruction Timing

CAT93C46R

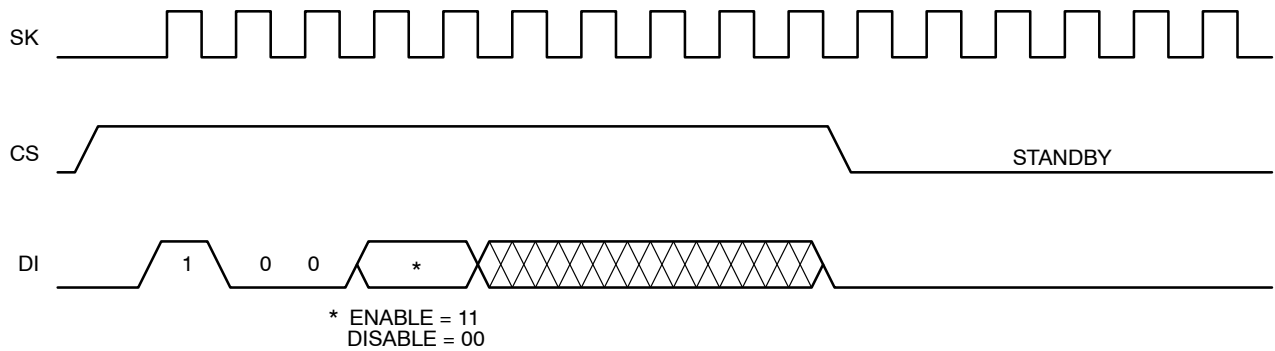


Figure 5. EWEN/EWDS Instruction Timing

Write

After receiving a WRITE command, address and the data, the CS (Chip Select) pin must be deselected for a minimum of t_{CSMIN} (See **Design Note** for details). The falling edge of CS will start the self clocking clear and data store cycle of the memory location specified in the instruction. The clocking of the SK pin is not necessary after the device has entered the self clocking mode. The ready/busy status of the CAT93C46R can be determined by selecting the device and polling the DO pin. Since this device features Auto-Clear before write, it is NOT necessary to erase a memory location before it is written into.

Erase

Upon receiving an ERASE command and address, the CS (Chip Select) pin must be deasserted for a minimum of t_{CSMIN} after the proper number of clock pulses (See **Design Note**). The falling edge of CS will start the self clocking clear cycle of the selected memory location. The clocking of the SK pin is not necessary after the device has entered the self clocking mode. The ready/busy status of the CAT93C46R can be determined by selecting the device and polling the DO pin. Once cleared, the content of a cleared location returns to a logical "1" state.

Erase All

Upon receiving an ERAL command, the CS (Chip Select) pin must be deselected for a minimum of t_{CSMIN} . The falling

edge of CS will start the self clocking clear cycle of all memory locations in the device. The clocking of the SK pin is not necessary after the device has entered the self clocking mode. The ready/busy status of the CAT93C46R can be determined by selecting the device and polling the DO pin. Once cleared, the contents of all memory bits return to a logical "1" state.

Write All

Upon receiving a WRAL command and data, the CS (Chip Select) pin must be deselected for a minimum of t_{CSMIN} . The falling edge of CS will start the self clocking data write to all memory locations in the device. The clocking of the SK pin is not necessary after the device has entered the self clocking mode. The ready/busy status of the CAT93C46R can be determined by selecting the device and polling the DO pin. It is not necessary for all memory locations to be cleared before the WRAL command is executed.

Design Note

With CAT93C46R, after the last data bit has been sampled, Chip Select (CS) must be brought Low before the next rising edge of the clock (SK) in order to start the self-timed high voltage cycle. This is important because if the CS is brought low before or after this specific frame window, the addressed location will not be programmed or erased.

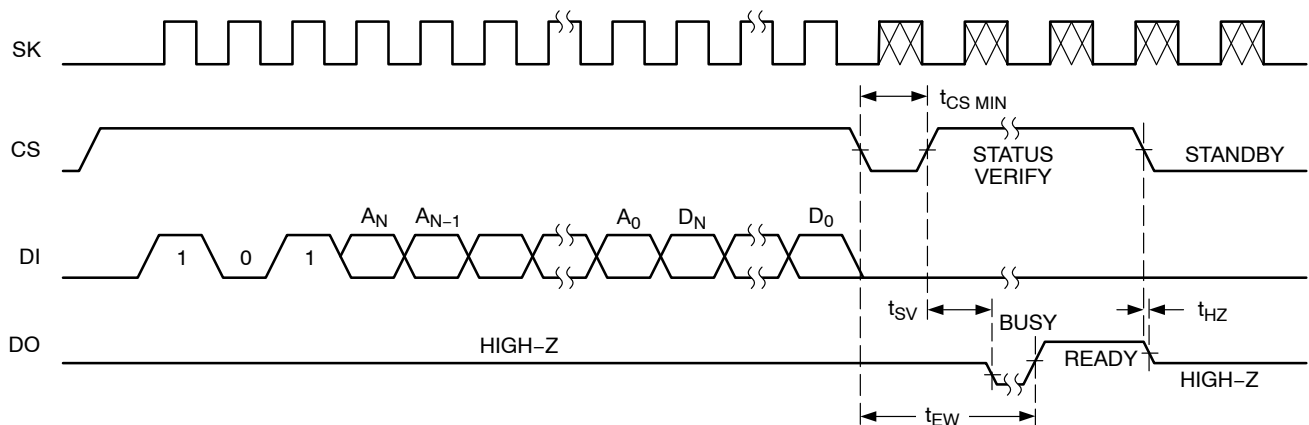


Figure 6. Write Instruction Timing

CAT93C46R

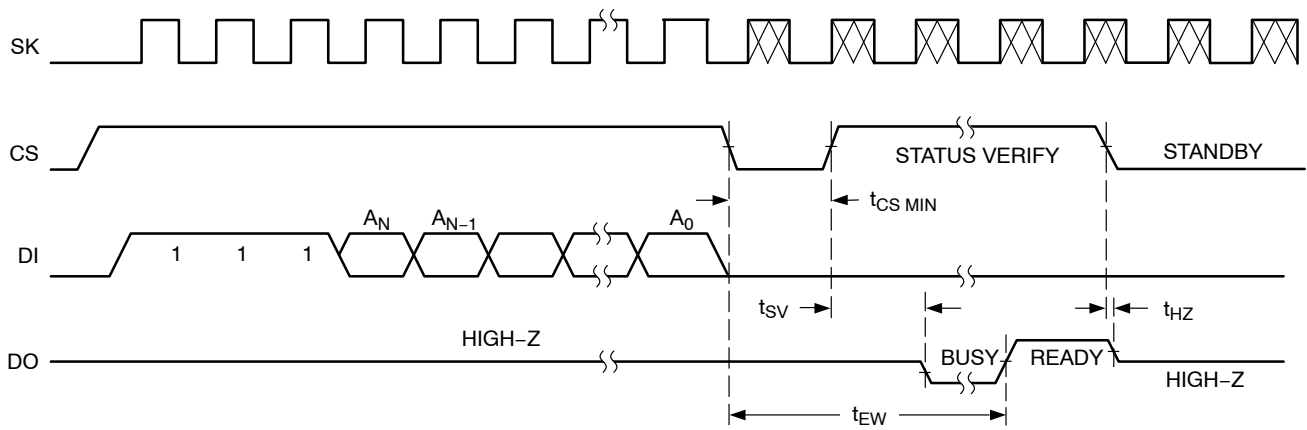


Figure 7. Erase Instruction Timing

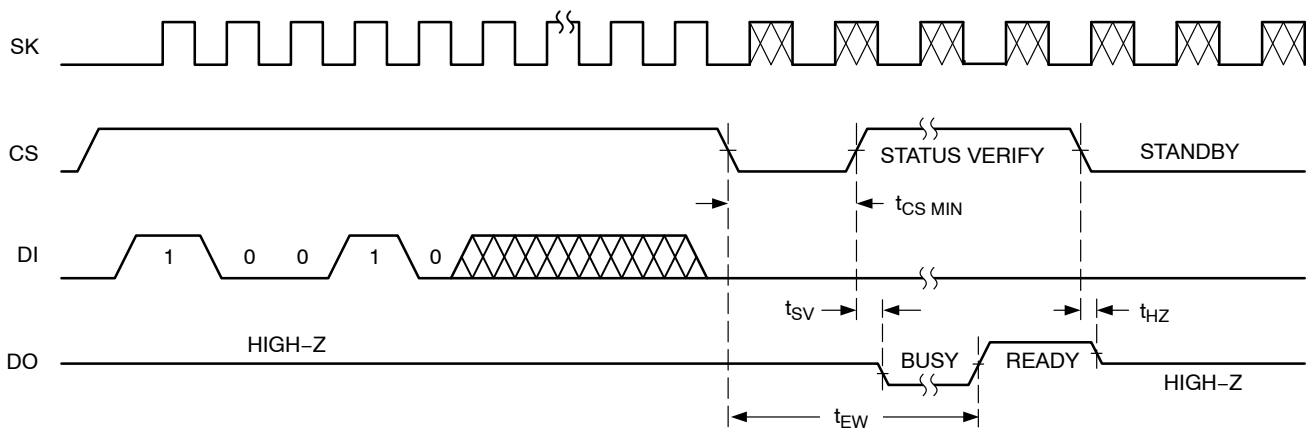


Figure 8. ERAL Instruction Timing

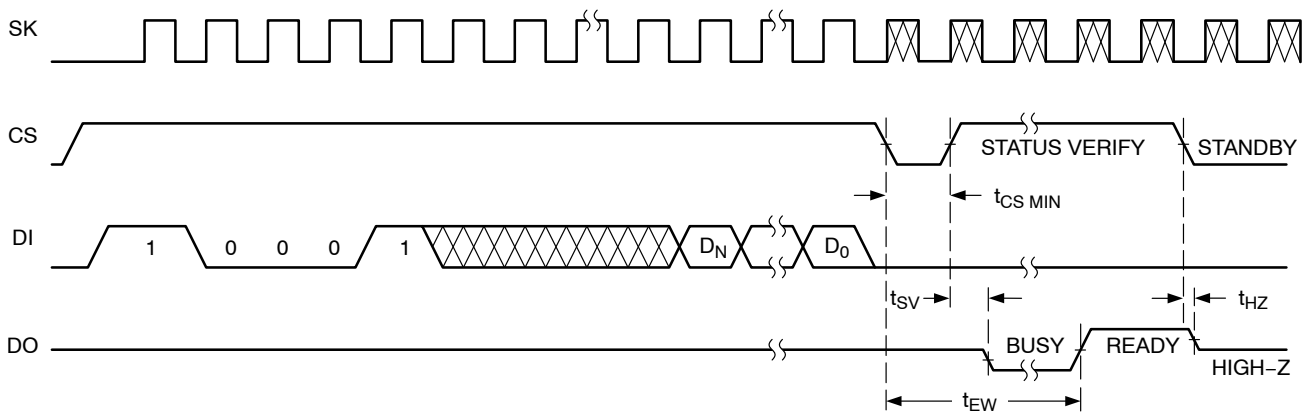


Figure 9. WRAL Instruction Timing

CAT93C46R

Ordering Information

OPN	Specific Device Marking	Pkg Type	Temperature Range	Lead Finish	Shipping
CAT93C46RLI-G	93C46RL	PDIP-8	I = Industrial (-40°C to +85°C)	NiPdAu	Tube, 50 Units / Tube
CAT93C46RVI-G	93C46RV	SOIC-8, JEDEC	I = Industrial (-40°C to +85°C)	NiPdAu	Tube, 100 Units / Tube
CAT93C46RVI-GT3	93C46RV	SOIC-8, JEDEC	I = Industrial (-40°C to +85°C)	NiPdAu	Tape & Reel, 3000 Units / Reel
CAT93C46RVP2IGT3 (Note 8)	EL	TDFN-8	I = Industrial (-40°C to +85°C)	NiPdAu	Tape & Reel, 3000 Units / Reel
CAT93C46RYI-G	46R	TSSOP-8	I = Industrial (-40°C to +85°C)	NiPdAu	Tube, 100 Units / Tube
CAT93C46RYI-GT3	46R	TSSOP-8	I = Industrial (-40°C to +85°C)	NiPdAu	Tape & Reel, 3000 Units / Reel

8. Not recommended for new designs.

9. All packages are RoHS-compliant (Lead-free, Halogen-free).

10. The standard lead finish is NiPdAu.

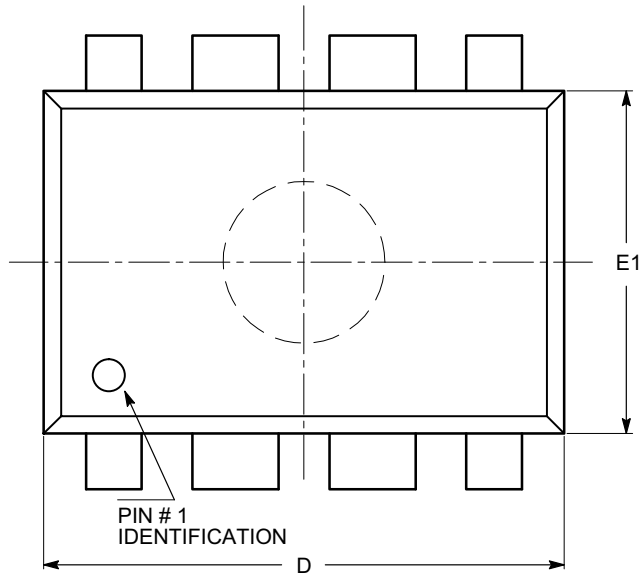
11. For additional package and temperature options, please contact your nearest ON Semiconductor Sales office.

12. For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

CAT93C46R

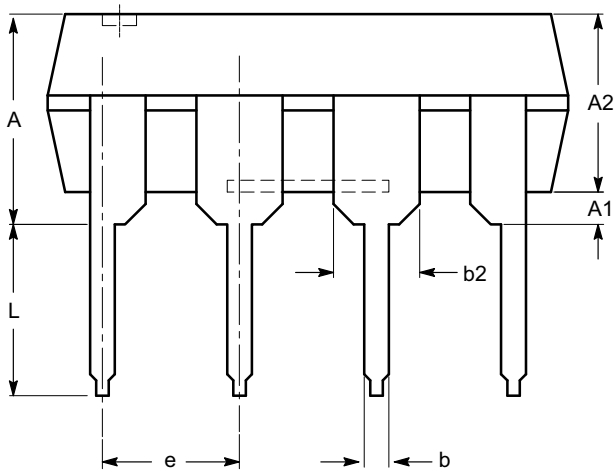
PACKAGE DIMENSIONS

PDIP-8, 300 mils
CASE 646AA-01
ISSUE A

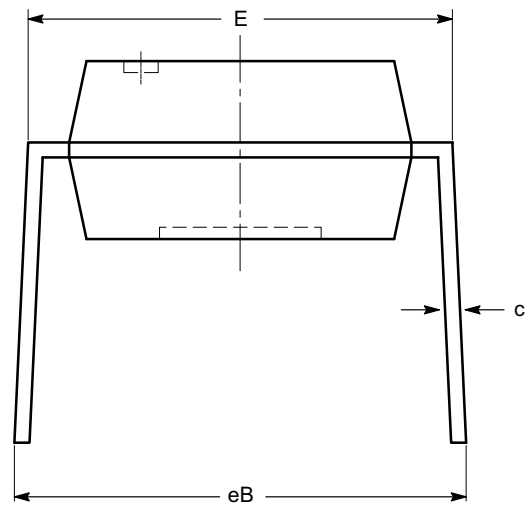


SYMBOL	MIN	NOM	MAX
A			5.33
A1	0.38		
A2	2.92	3.30	4.95
b	0.36	0.46	0.56
b2	1.14	1.52	1.78
c	0.20	0.25	0.36
D	9.02	9.27	10.16
E	7.62	7.87	8.25
E1	6.10	6.35	7.11
e	2.54 BSC		
eB	7.87		10.92
L	2.92	3.30	3.80

TOP VIEW



SIDE VIEW



END VIEW

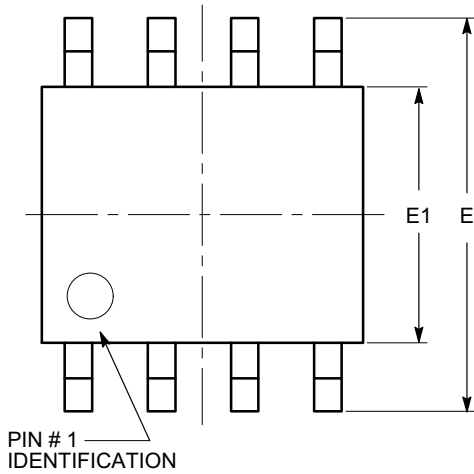
Notes:

- (1) All dimensions are in millimeters.
- (2) Complies with JEDEC MS-001.

CAT93C46R

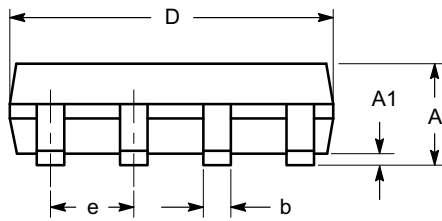
PACKAGE DIMENSIONS

SOIC 8, 150 mils
CASE 751BD-01
ISSUE O

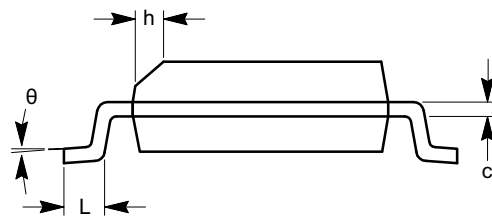


TOP VIEW

SYMBOL	MIN	NOM	MAX
A	1.35		1.75
A1	0.10		0.25
b	0.33		0.51
c	0.19		0.25
D	4.80		5.00
E	5.80		6.20
E1	3.80		4.00
e	1.27 BSC		
h	0.25		0.50
L	0.40		1.27
θ	0°		8°



SIDE VIEW



END VIEW

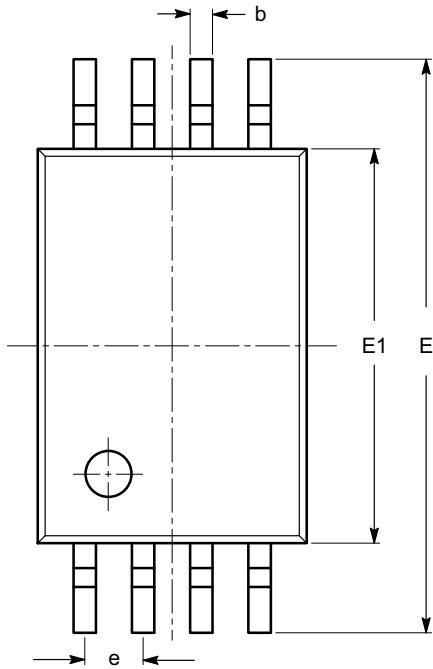
Notes:

- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MS-012.

CAT93C46R

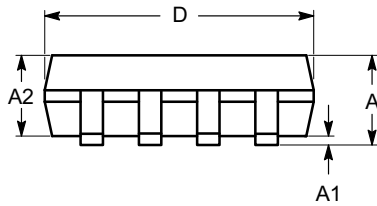
PACKAGE DIMENSIONS

TSSOP8, 4.4x3
CASE 948AL-01
ISSUE O

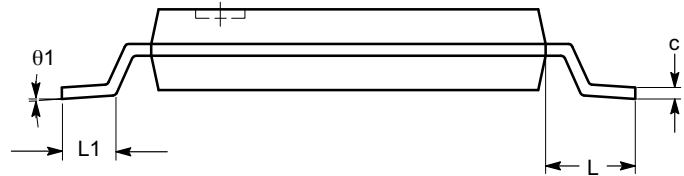


SYMBOL	MIN	NOM	MAX
A			1.20
A1	0.05		0.15
A2	0.80	0.90	1.05
b	0.19		0.30
c	0.09		0.20
D	2.90	3.00	3.10
E	6.30	6.40	6.50
E1	4.30	4.40	4.50
e	0.65 BSC		
L	1.00 REF		
L1	0.50	0.60	0.75
θ	0°		8°

TOP VIEW



SIDE VIEW



END VIEW

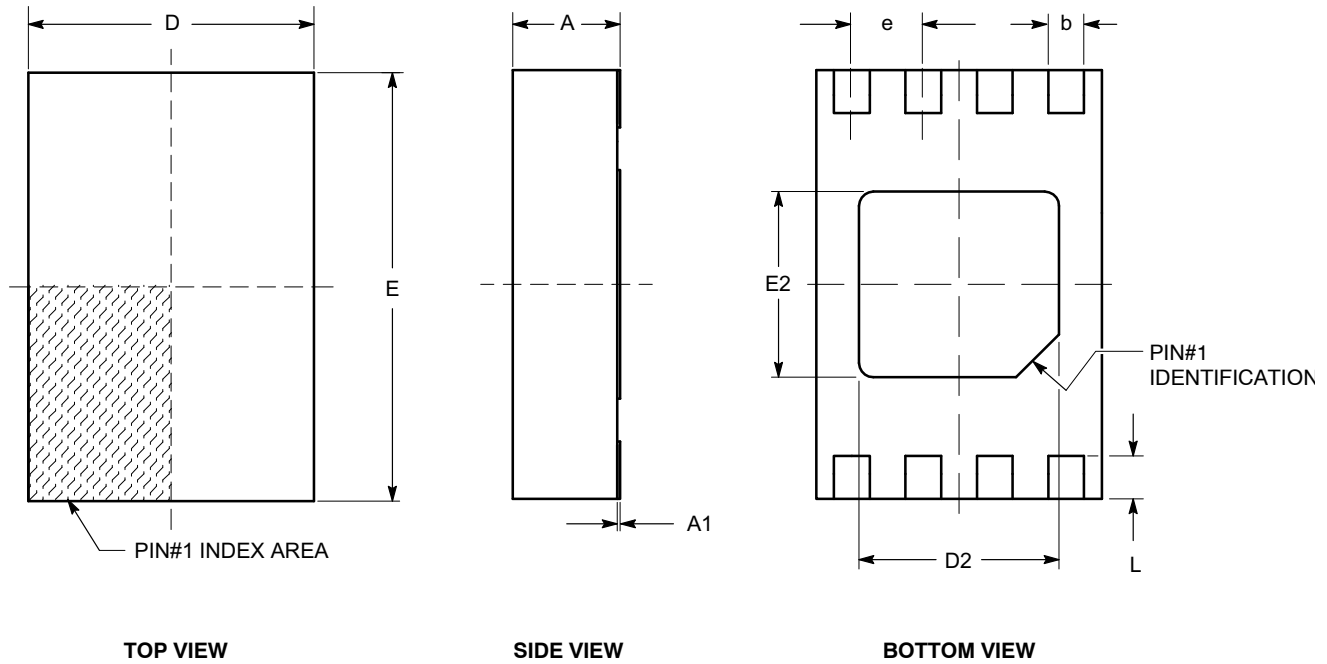
Notes:

- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MO-153.

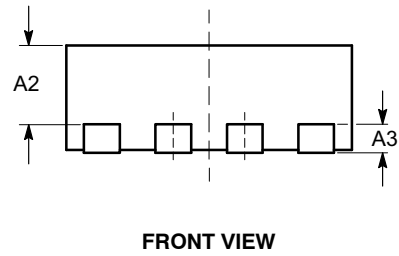
CAT93C46R

PACKAGE DIMENSIONS

TDFN8, 2x3
CASE 511AK-01
ISSUE A




SYMBOL	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A2	0.45	0.55	0.65
A3	0.20 REF		
b	0.20	0.25	0.30
D	1.90	2.00	2.10
D2	1.30	1.40	1.50
E	2.90	3.00	3.10
E2	1.20	1.30	1.40
e	0.50 TYP		
L	0.20	0.30	0.40



Notes:

- (1) All dimensions are in millimeters.
- (2) Complies with JEDEC MO-229.

CAT93C46R

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative